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DIABETES

A brief account of the dietetic
measures used in this disease
from the earliest records to the
present time.

Containing a complete exposition of the
carbohydrate-free treatment with the
reasons which have led to its abandonment
by the leading medical authorities.

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To those medical scientists
whose writings have been its
principal source, this little
work is respectfully dedicated.

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FOREWORD.

Increasing popular knowledge of the general nature of diabetic treatment, renders the inclusion in this pamphlet of matter dealing with the purely medical aspects of that disease unnecessary and inappropriate, as such knowledge can only be given with authority by the physician.

The scope of this short account is therefore limited to a description of the evolution of the present dietetic method.

It is hoped that the information given, supported by very complete references to the highest authorities, will enable the patient to give that co-operation to his physician which the latter requires if the best results are to be obtained from the treatment.

DIABETES.

1. The Beginnings of Dietetic Treatment.

Nothing, perhaps, more vividly illustrates the continuous progress of medical science than the history of the treatment of diabetes. This disease was recognised as a distinct morbid process by ancient writers, but nothing was known of its real nature until 1776 when Dobson demonstrated the presence of sugar in the urine of diabetic patients. From that time, corrective treatment became possible, but, strangely enough, the first measures which were applied were exactly the reverse of what was needed. It was thought that as the body lost an excessive amount of sugar, the deficiency might be compensated by increasing the proportion of saccharine substances in the diet, and large quantities of honey and sweet fruits were given, to those who suffered from diabetes. The effect can easily be imagined; it was soon perceived that this treatment was disastrous and that circumstance led not only to its abandonment but also to its complete reversal. A new system, known as the meat, or carbohydrate-free dietary was introduced by Rollo in 1797; it represented the other extreme in dietetic methods as it aimed at the total exclusion of carbohydrates, and from this period, the treatment of diabetes entered a new phase.

2. The Carbohydrate-free System.

Two things were now definitely known concerning diabetes: first that it was characterised by an excessive excretion of sugar, and secondly that an increase of starch or sugar in the diet led to rapid aggravation of the symptoms. It was on these grounds that John Rollo introduced his famous carbohydrate-free system which, although now entirely discredited, must, for several reasons be carefully examined.

The carbohydrate-free system, as the term implies, involved the elimination of all sweet or starchy foods from the dietary. The patient lived mostly on meat and soups, with the addition of small quantities of green vegetables; every other kind of food was prohibited. The result was that the excretion of sugar was largely arrested, and, in mild forms of diabetes, the progress of the disease was delayed for varying periods. It was soon noticed, however, that, whilst the loss of sugar was held in check, other symptoms of a far more serious nature developed, at times with great rapidity. The first effects were emaciation and extreme weakness; after a time the patient became feverish, and sooner or later entered into a state of coma which ended fatally within a very short time (1). Obviously, therefore, there was a radical defect in the carbohydrate-free system, because the completely starchless diet aggravated the more dangerous symptoms and hastened the fatal termination. That, however, was neither known to, nor even suspected by Rollo and his immediate followers. The dangers of the carbohydrate-free system were not thoroughly understood until recent years, and to explain their nature, a brief summary of the results of later discoveries is necessary.

3. The Principle of the Balance of Food Substances.

The term metabolism, so frequently used, may be taken to mean the utilisation of the digested food which passes into the blood. Diabetes is a condition of disordered metabolism; that is, that although the system may receive all the food substances necessary for nutrition and muscular effort, it fails to utilise them in the normal manner. Human food consists of three principal elements:

- (i) **The Carbohydrates**, that is the various forms of starch and sugar. All carbohydrates are converted into grape-sugar and as glucose pass into the blood in the process of digestion.

(1) This and subsequent numbers refer to the appendix at end of book.

- (ii) **The Proteins**, the nitrogenous or albuminous food-stuffs. The lean parts of meat are almost pure protein, and in fish and eggs the proportion is very high. There are also vegetable proteins, of which the gluten of wheat is the best example. In certain cases 58 per cent. of protein food may be transformed into sugar in the system.
- (iii) **The Fats**, both animal and vegetable: 10 per cent. of fatty foods may form sugar in the system.

It is now known that for the proper utilisation of food by the body, a balance of these three elements, the carbohydrates, proteins, and fats must, as far as possible, be maintained in the diet. In diabetes, and many other diseased conditions, it may be necessary to reduce the quantities of any of the food elements, or even to suspend them altogether for a time, but none of them can be permanently eliminated without disastrous consequences.

That is merely the statement of a natural law confirmed by modern research. Extensive investigation has shown not only that all three food elements are necessary for nutrition but also that they must be contained in the diet in fairly definite proportions. The quantities of each substance necessary for proper nutrition differ according to the weight of the individual; the nature of his work: climatic or other conditions. The average daily requirements for a normally active person given by Dr. Hutchison (2) are as follows:—

**The Principal
of Balance
confirmed by
Modern
Science**

Proteins	100 grams	or	16 per cent.
Carbohydrate	450 „	or	72 „ „
Fat	75 „	or	12 „ „

The outstanding feature of the normal diet is therefore the great preponderance of carbohydrate, and this circumstance alone is an indication that the drastic method of total exclusion is fundamentally unsound. There is the further circumstance that complete withdrawal of the carbohydrates involves an abnormal increase in the amounts of protein and fat and thus the balance of food is entirely destroyed.

The effect of the complete destruction of the food balance is now very clearly understood. The processes by which the three food elements are metabolised in the system are interdependent; each substance aids in the proper conversion of the others. This inter-action is particularly marked in the case of carbohydrates and fats: **for the continuous utilisation of fats the presence of a minimum of carbohydrate in the food is absolutely necessary.** In the healthy body on a normal diet, the fats undergo rapid changes. When completely transformed in the blood they go to form the fatty layers beneath the skin which preserve the heat of the body, or they are burnt up as fuel for the production of energy (muscular effort). Without the proper supply of carbohydrate the burning process is imperfect; the fat is not consumed but remains in the intermediate forms of di-acetic or aceto-acetic acid, and acetone. "In the absence of carbohydrates," says Dr. Langdon Brown, "the fats are incompletely oxidised to di-acetic acid, the source of the acetone in the urine and breath" (1). The accumulation of these substances in the blood constitutes the dangerous condition known as **acidosis**; the di-acetic acid is itself poisonous or forms poisonous compounds with proteins in the blood, and if acidosis becomes at all pronounced, **coma is the inevitable result.**

4. The Further Course of the Carbohydrate-free System.

All this was unknown to Rollo, and indeed to the two generations which succeeded him. They were quite unaware that the exclusion of all carbohydrate from the diet involved the production of poisonous substances in the blood. They did not connect the occurrence of the fatal symptoms of **carbohydrate-free system.** coma with dietetic causes; it was regarded merely as the unavoidable final stage of the weakness due to continued loss of sugar, and on these grounds increased efforts were made to exclude carbohydrate and to ensure nutrition by supplying practically nothing but protein food. This measure was obviously so harmful that criticism arose after a few years

experience of its results. As early as 1837, the writer of a singularly enlightened article in a current publication (3), condemned the exclusively animal diet then prescribed, as impracticable and unscientific. "Books have been written," he says, "to show that it should constitute the sole diet, but it never can constitute the sole diet—. Physiology has demonstrated that life cannot be sustained on one kind of food alone, however nutritious—experience has fully shown that all the curative effect which can be obtained from what is called the animal regimen, is accomplished by making animal matter the principal part of the diet, and combining with this a small proportion of the farinacious vegetables."

Unfortunately, these views were not generally accepted: the all-meat diet was strictly enforced in nearly every case, with the result that the mortality at a very early stage of the disease was extremely high. **The beginning of the end of the carbohydrate-free system.** Matters remained in this exceedingly unsatisfactory position until 1891 when it was discovered that sugar could be formed from proteins as well as from the carbohydrates, and this important discovery led to an immediate modification of dietetic methods. The diabetic dietary at that time consisted almost entirely of lean meat, and when it was found that this could give rise to sugar, it was considered necessary to reduce the quantity. The carbohydrates were still rigorously excluded, so the only means of effecting a reduction of the lean meat protein was by increasing the quantity of fat, and this was done. It is unnecessary to dwell on the result of this measure; the increase of fat meant an increase in the frequency of acidosis and coma. The last form of the carbohydrate-free system was, in fact, more harmful than the first.

Meanwhile a new school was coming into existence. Stadelmann had discovered oxy-butyric acid (from which di-acetic acid is formed in the blood) in 1883, and a large number of English practitioners claimed, on chemical grounds, that the occurrence of acidosis with its consequent disasters was due to the total exclusion of carbohydrates from the diet. It seems strange now to note

how strenuously they were opposed by the adherents of the moribund carbohydrate-free system. As late as 1895 Von Noorden wrote, "the common source of aceto-acetic (diacetic) acid, and oxy-butyric acid, is without doubt albumin" (protein). He refused to admit that it had been proved that the total exclusion of carbohydrates favoured the occurrence of coma. He said that an all-meat diet might be a predisposing condition, but "that cannot be asserted of a generous fat and flesh diet" (4). This remarkably dogmatic statement was soon proved, in the most practical manner, to be wrong. The fact is that **those physicians who allowed their diabetic patients to take small quantities of carbohydrate food obtained surprisingly improved results.** "It was recognised," says Dr. Cammidge, "that the more completely carbohydrates were excluded from the diet, the more certain was coma to supervene, while the addition of starchy foods delayed the onset in many instances." (5).

Dr. Cathcart (Grieve Lecturer on Chemical Physiology at Glasgow University) even went so far as to say in an article in the Glasgow Medical Journal, that, "several modern workers maintain that it is nothing short of a criminal act to withhold absolutely, carbohydrate from a diabetic."

Before concluding this account of the early forms of treatment of diabetes, it may be noted as a curious fact, that the hold of the carbohydrate-free system on the popular mind continued long after its dangers had been clearly demonstrated. It might, indeed, be said that even to-day the old error has not entirely disappeared, for in spite of all scientific teaching to the contrary, there are people who still believe that the smallest quantity of starchy food is harmful to the diabetic patient. How far that view is incorrect will be readily seen from the following account of the modern dietetic treatment of diabetes, and the enormous benefits which have been secured by its introduction.

5. The Modern Dietetic Treatment of Diabetes.

The Starch-reduced dietary.

As stated in the Foreword there is no intention here of dealing with the purely medical aspects of diabetes. For the proper understanding of the modern system, however, and the accurate dietary regulation that it entails, in which the patient is called upon to co-operate, a brief and partial statement of the nature of the disease is now necessary.

The complex nature of diabetes.

Diabetes was known to Rollo and his followers merely as a condition in which sugar was excreted in the urine, and they regarded coma only as the natural outcome of the weakness caused by mal-nutrition. By the beginning of the present century it was known that the comatose condition is provoked by the toxic acids produced by incomplete metabolism of fats. Further, in certain forms of the disease, protein also may be imperfectly metabolised and give rise to a considerable quantity of sugar in the blood. It was evident, therefore, that not one, but all three metabolic processes were impaired, or tended to become so in the progress of the malady. As Dr. Clarke Begg says, "Diabetes is a disease of general metabolism" (6). In the early stages it usually consists only in reduced ability to utilise starchy foods, but "there is a tendency to subsequent disturbance of fat metabolism with resulting acidosis—the products of incomplete combustion accumulate in the system and suffocate the patient as effectually as does the CO of a charcoal stove" (7). The position is fully stated by Dr. Hugh Maclean. "Diabetes is sometimes referred to as a condition in which the specific defect is an inability of the body to deal with starchy food, and no notice is taken of the fact that defects in fat and protein metabolism may play an equally large part in the malady." (8).

It was this more complete knowledge of the nature of diabetes which led to the final rejection of the carbohydrate-free system. It was recognised that by suitable modifications of the diet the occurrence of the deadly comatose condition might very largely be eliminated. "Coma is more generally due to faulty dieting with excess of protein and fat than an

Progress of the new method.

essential part of the disease " (1) and the first step of the new school was to re-include starchy foods in the diabetic dietary. The task was extremely difficult as an undue proportion of carbohydrates led to an increase of sugar in the urine, and an excess of meat and fats induced acidosis in many cases. Careful observation of patients under treatment in hospitals however, led to the establishment of fairly satisfactory methods of determining suitable quantities of starch, protein and fat for the greater number of cases, and immensely improved results were obtained.

There remained, however, a large number of cases which came late under treatment or in which the progress of the disease was very rapid, and for these very little could be done. The independent discovery of the great benefit conferred on diabetics by a period of alimentary rest, by Dr. George Graham (9) in England, and Dr. Allen (10) in America supplied a method by which cases even of this class might effectively be treated. The principle is concisely stated by Dr. Leyton: " A period of alimentary rest leads to the metabolism of a diabetic approaching that of a normal individual. A patient suffering from severe diabetes is unable to utilise even the carbohydrate part of protein; after alimentary rest not only is he able to utilise the carbohydrate of protein but also able to oxidise some starch. This acquired tolerance is fostered. A limit for protein and for fat is found " (11).

Allen's method and Graham's " Ladder Diet " system differed in detail, but the object in both cases was to render the urine absolutely sugar free, by a period of fasting, and to keep the patient on a low maintenance diet for some time, after which carbohydrate was gradually introduced into the diet with the result stated by Dr. Leyton. In one form or another, these systems were almost invariably employed in the more advanced cases of diabetes, and frequently saved the patient, even when coma was imminent. The result was that the mortality from diabetes was still further reduced, and from the time of the introduction of the Graham and Allen systems, it may be said that the modern dietetic treatment of diabetes was firmly established.

6. The Modern Treatment contrasted with the Old Carbohydrate-free Method.

It is not an easy matter to compare the results obtained by the old carbohydrate-free system and the new starch-reduced method because reliable statistics are not available, but the quotations which follow present the matter in a vivid light. Writing in 1910, Dr. Julius Dreschfeld stated that

Some Striking figures.

about half of the number of diabetic cases died from coma (12). What happened within the next few years may be seen from the improved results secured at Guy's Hospital under the direction of Dr. E. P. Poulton. "Poulton found that at Guy's Hospital, whereas formerly the mortality during the first year of the disease was 16.9 per cent., it is now only 5.4 per cent.; the average mortality rate of all cases admitted has been reduced from 23 per cent. to 7.7 per cent.; and whereas only 9.8 per cent. were formerly made free from sugar, even for a day, 73.5 per cent. can be rendered free for longer or shorter periods."

(1). This was written in 1921 before the introduction of Insulin. The next quotation is from Dr. Elliott P. Joslin's recent book; it relates to conditions in America and is similarly instructive. "How much the methods of treatment have improved during the recent years," he says, "is best shown by the statistics for diabetes of the Massachusetts General Hospital. Between 1824 and 1898 for every 100 diabetics who entered the institution 27 died within its walls, but during 1918 which is long before the discovery of insulin, so great had been the improvement, by dietetic methods alone, that there were but 4 deaths per 100 admissions." (13).

7. The perfecting of the Modern Method.

The improvement in methods of dietetic treatment of which Dr. Joslin speaks has continued up to the present day,

The precise determination of the food balance.

and diabetic dietaries which represent the exact food balance suitable for each individual patient, are now precisely determined. How that marvel of medical science has been effected could not be told within the limits of this pamphlet; it resulted mainly from the studies of

Newburgh, Marsh, Woodyatt, and Shaffer (14). In practice the process is as follows:

The degree of tolerance of **carbohydrate** of the patient is first established. This is ascertained by urine analysis, or in doubtful cases by analysis of the blood. Rather less than the amount of carbohydrate which can be tolerated is allowed.

The amount of **protein** is calculated on a basis of approximately 1 gram per kilogram of body weight.

Fat is added in quantities sufficient to ensure the requisite number of calories *i.e.*, units of food capable of producing a certain quantity of heat when consumed.

The scheme may be modified in special circumstances, as for instance, when acidosis occurs, in which case the fat may be withdrawn and the carbohydrate increased.

When the total needs of protein, carbohydrate and fat, have been ascertained, the next step is to find the proportionate quantities of the various food substances necessary. Simple as it may now appear, the determination of these proportions presented very great difficulties, as the exact composition of most of the food stuffs was unknown, until within the last few years when Food Tables (15) giving the percentage of the three food elements in a large variety of substances, have been published. By means of these tables the physician can decide on the quantity of each kind of food for the daily allowance, and in this way build up a complete dietary which will meet the requirements of each individual case.

Considerable care is needed for the arrangement of dietaries in severe cases, when what is known as the precise dosage of carbohydrate, protein, and fat becomes necessary. This will readily be seen from the following analyses of two ordinary and apparently similar fish; cod and herring (16). The samples analysed were fresh fish in the raw state: 100 grams of each were taken: water is not shown.

Fish				Protein	Carbohydrate	Fat	Calories
Herring	...	...	...	12.1	nil	10.95	151.4
Cod	...	...	...	14.6	nil	0.1	65.3

This example shows that the substitution even of small quantities of herring for cod, whilst it would make but little difference in the amount of protein, would seriously disturb the balance of fat and the number of calories in the dietary. The same is true of different kinds of meat, and in these circumstances it will be seen that even in mild cases of diabetes, the patient should never make changes in his diet unless they are approved by his physician.

8. The Carbohydrates: Starch - reduced Products.

It goes without saying that careful estimation of the amount of carbohydrate in the diet is absolutely necessary.

The carbohydrates remain the most important factor in dietetic treatment: a deficiency is liable to provoke acidosis, an excess will certainly give rise to sugar in the urine. The object of the modern treatment is to steer carefully between these two extremes; the exact determination of the quantity of carbohydrates in the daily food is therefore the central point of the system.

The carbohydrates are nearly all of vegetable origin, milk being the only important exception. The amount of starch or sugar which the ordinary vegetables contain may be gathered from the Food Tables: the range is very wide, extending from 5 per cent. in cabbage to 20 per cent. in potatoes (raw), and it is therefore usually an easy matter to include fair quantities of vegetables in the dietary, well within the limits of the carbohydrate allowance.

The cereal products, and in particular bread, constitute the real crux of diabetic dieting. Two very great difficulties present themselves in this case. In the first place the percentage of carbohydrate is very high in cereal foods; the quantities which the patient may take are usually unsatisfying, and a slight excess may cause re-appearance of sugar in the urine. In the next place the composition of cereals varies considerably under different conditions. Bread is the worst offender in this respect: the ordinary household

loaf contains about 50 per cent. of water when quite new, but a large proportion of this water evaporates. As the percentage of water decreases the percentage of starch rises, and in a single day the same loaf may represent varying carbohydrate values, and the variation is often sufficiently wide to constitute a distinct danger to the patient.

The difficulty of providing suitable cereal foods in satisfying quantities, has been overcome by the introduction of standardised starch-reduced breads and other farinaceous foods. For the proper and scientific preparation of these articles a process known by the registered name of **Starch-reduced Products.** Energen is now employed. This process consists in the extraction of a high proportion of starch from the wheat flour and other cereal products; this starch-reduction being carried to a fixed point in every case (standardisation). The resulting products, Energen Bread, diabetic biscuits and other cereal foods, therefore possess the very great advantage of invariable composition with a determined amount of carbohydrate. With the analysis before him the physician can decide at once exactly how much of any or all of these foods to include in the patient's dietary.

9. Conclusion.

It will be seen from the foregoing that the dietetic treatment of diabetes has developed from an incorrect and, indeed, harmful method to a system of fine adjustment. Of the advantages which have accrued to the sufferer from diabetes it is hardly necessary to speak. On the all-meat carbohydrate-free diet, which, as we have seen, persisted until recent years, the patient was kept constantly in a state of under-nutrition, and, as the figures quoted show, the progress of the disease was rapid. The vast improvement from every point of view, effected by the introduction of the modern method, is best stated in the words of Dr. Hugh Maclean. "Often," he writes, "it is possible to give the necessary nourishment to the patient, and yet maintain a condition in which the urine is both sugar and acetone free." (8).

"The aim of the clinical treatment of diabetes," says Dr. A. P. Thomson, "is the comfort and efficiency of the patient" (17) and the suppression of the dangerous symptoms and the provision of a satisfactory diet represent the accomplishment of that aim.

In concluding this account of the evolution of the dietetic method in diabetes, it should be pointed out to the patient that the knowledge he may gain of the nature of diabetes from this little work, and should he wish to study them, the publications to which reference is made, will help him to that co-operation with his physician which is essential to the successful treatment of his case. "It is well to realise at the outset" says Dr. E. G. B. Calvert, "that no two cases of diabetes are alike—each is a law unto itself, and must be treated accordingly" (18). Consequently in deciding on the dietary to be followed in each individual case, the physician is guided by a number of considerations other than the simple dietetic rules, which have been referred to. He takes into account the state of nutrition of the patient, the degree of vitality as evidenced by heart beat and other reactions, the condition of the skin, the occurrence of abscesses, and a host of other indications. These things involve modifications in the treatment of which the physician alone is competent to judge.

APPENDIX

Drugs and Insulin.

Non-dietetic forms of treatment lie without the scope of the present pamphlet and are dealt with here only in so far as they affect the question of dietary regulations.

No mineral or vegetable agent has ever been found of any avail in the direct treatment of diabetes. Naturally enough, when the earlier dietetic methods gave little or no relief, innumerable drugs were tried to redeem the failure. A very long list of reputed remedies, ranging from powdered egg-shell to antipyrine is quoted by Dr. Robert Saundby (19) but their use is now entirely abandoned. "The attempt to influence the sugar metabolism by drugs has been given up

as useless" (9) says Dr. Graham. Drugs are at times prescribed to correct incidental symptoms, such as constipation, but in the treatment of the specific condition, as Dr. Langdon Brown puts it "Diet remains the sheet anchor." (1).

This is equally true when the Insulin treatment is applied. For information concerning Insulin the reader is referred to the books and articles (20 & 21) mentioned on the following page. The point of importance here is that every authority has insisted on the necessity of maintaining dietary regulation during and after the Insulin treatment. (21). Unfortunately the warning has been neglected in many cases, with disastrous results, and it cannot be too often repeated. In the words of Dr. K. S. Hetzel, "Insulin has not removed the need for an accurate control of food in diabetes, it has rather emphasized that need." (22).

References and Notes.

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- (21) A summary of medical opinion on this point will be found in **Insulin: A Simple Explanation of the New Treatment of Diabetes.** London, 1923, issued by the Therapeutic Foods Co., Ltd. This little work provides an excellent introduction to the subject.
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